

Space Weather Technical Forecast

Issued on Saturday, 21 September 2024 at 13:14 Local

From the 24th of September, the way we distribute this forecast is changing and you will need to take action to continue receiving it. You should have received an email on the 4th of September explaining the steps required to do this. If you have already signed up to receive the forecast on our premium website, please disregard this message. If you haven't, or if you need help with the process, please contact moswoc@metoffice.gov.uk

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-flares (R1-R2 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with only occasional C-class flares observed, peaking C3.9 at 20/1457 from AR3831, now just west of the north-centre disc. There are seven sunspot regions on the disc, however these are all generally quite inactive. AR3831, and the nearby AR3833 saw the most notable growth, but are now maturing into relatively simple magnetic configurations. However, there remains a weak delta spot on the leader of AR3831. AR3828 in the southeast is the next most complex spot, but has seen ongoing development and decay of surrounding peripheral spots. AR3825 in the southwest disc continues to decline, with the other regions small and simple.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Slow wind conditions persisted. Solar wind speeds, as observed by ACE at L1, eased from slightly elevated to be at background, from 440 km/s to near 350km/s. Density was near or below average. Interplanetary Magnetic Field, Bt, was weak throughout at 2-7nT, with north-south component, Bz, fluctuating weakly between +6nT and -5nT. Phi angle was initially positive (away from the Sun), but switched to negative (towards the Sun) at around 21/000 UTC. Geomagnetic activity was mostly Quiet (Kp 0-2), but saw one interval of Active (Kp4) 21/2100-0000 UTC.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was mainly Moderate but rose to High in the period between 20/1415-2000 UTC, peaking 1240 pfu at 20/1820 UTC. The associated 24-hour fluence remained below Active but showed a rising trend until midnight before plateauing, with the 21/0000UTC observation 5.65e7 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of isolated M-class flares.

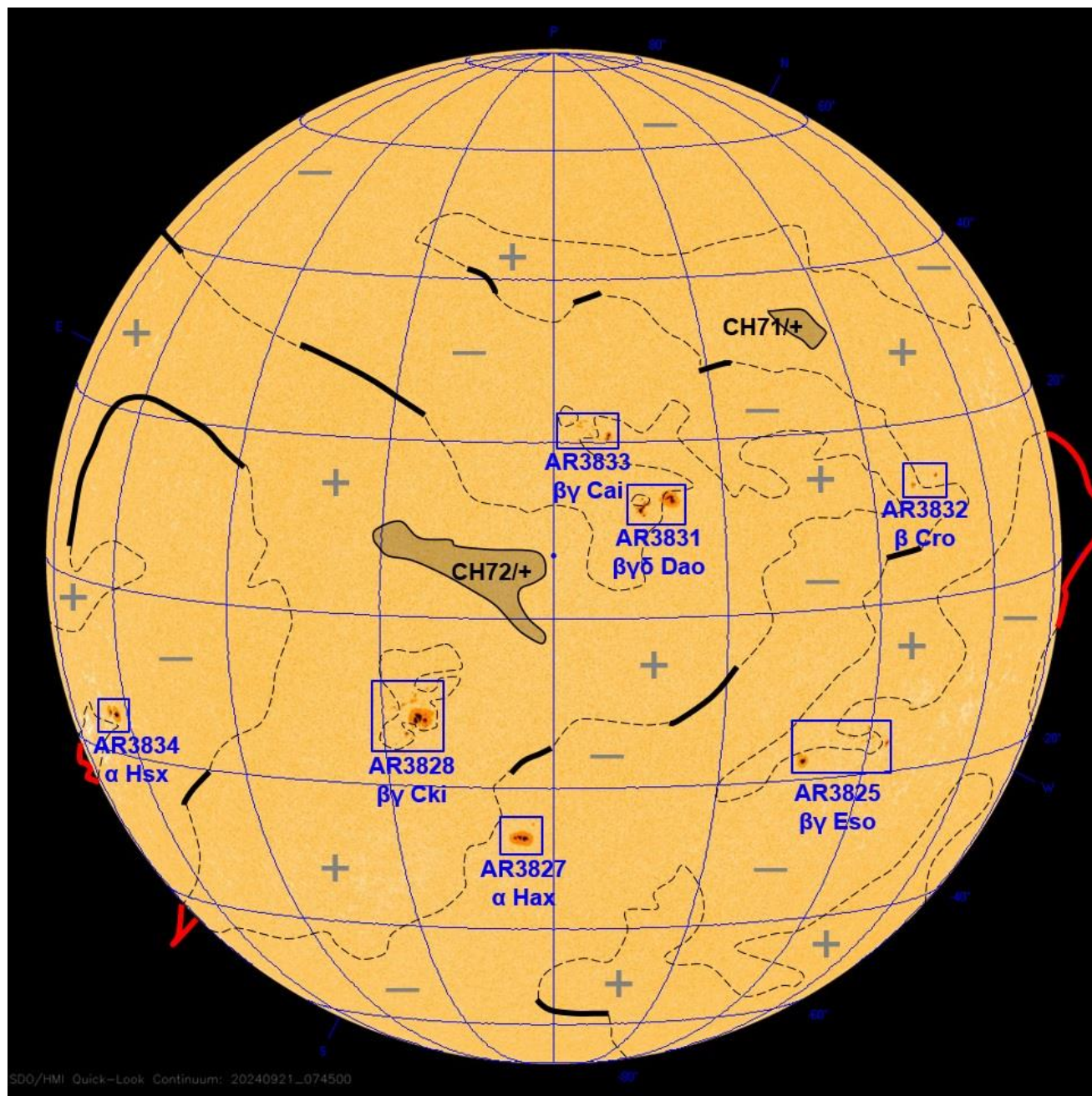
Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Slightly elevated solar winds are expected to ease to mainly background. Chance of slight enhancement day 2-3 (22-23 Sep) from any interaction with the fast wind of small CH71/+ in the northwest. Further enhancement possible late on day 4 (24 Sep) from any fast wind enhancement from CH72. Mainly Quiet activity forecast (Kp 0-2) with isolated Unsettled (Kp 3) intervals and a slight chance of a spell of Unsettled to Active (Kp 3-4) late day 2 or day 3. Any onset of CH72 will bring a slight chance of Active to G1 Minor Storms (Kp4-5) at the end of day 4.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is expected to

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remain at Background. High energy electron flux is forecast to be Moderate with diurnal peaks at High. There is now a reduced chance of more persistent High flux occurring with only a slight chance of the associated 24 hour fluence breaching the Active threshold.

Figure 1. Solar Analysis Valid 21/0800 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

There are no Earth-directed CMEs.

Solar winds are expected to be mainly at background through the period. While now considered unlikely to be observed, there remains the small chance of a weak enhancement later day 2 or day 3 (22-23 Sep) from the small northern coronal hole CH71/+. Confidence is very low due to its small size and northern position, however, given this period is over the September equinox, then the positive polarity of the coronal hole increases the potential some increased geomagnetic activity should it be observed.

Connection to a HSS from CH72/+ in the eastern hemisphere is most likely to occur beyond the forecast period, but there is a chance for this onset to be at the very end of day 4 (24 Sep). This coronal hole is in a similar position to on the previous rotation, but appears stronger and extends slightly further west on this occasion, suggesting a stronger response and greater possibility of enhancement. This is also a positive feature, increasing the potential for enhancement.

Geomagnetic activity is forecast to be mainly Quiet (Kp 0-2) with isolated Unsettled (Kp 3) intervals and a slight chance of a spell of Unsettled to Active (Kp 3-4) late day 2 or day 3. Any onset of CH72 will bring a slight chance of Active to G1 Minor Storms (Kp 4-5) at the end of day 4.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	5	5	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

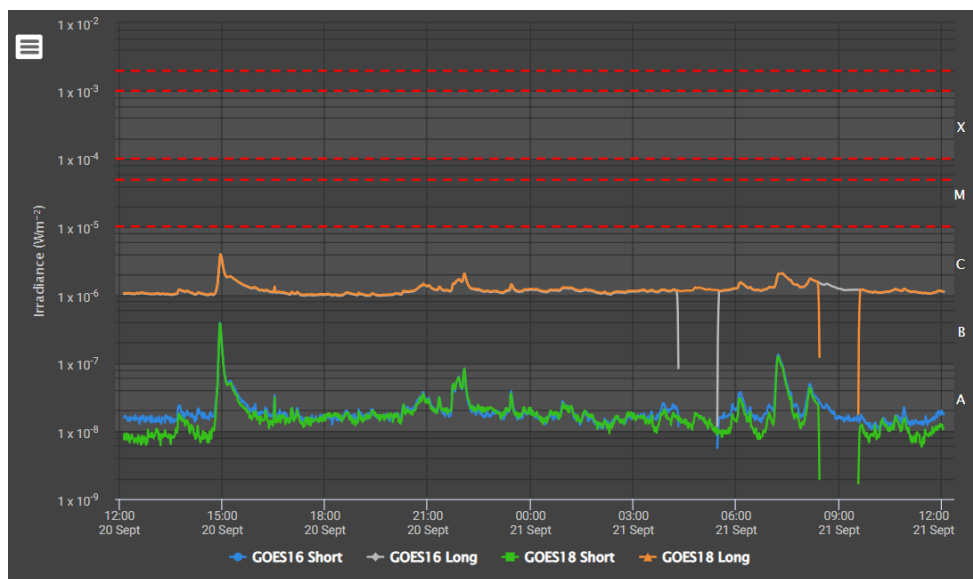
Low to Moderate activity is expected with seven sunspot regions currently on the disc.

The most notable region is perhaps AR3831 just west of the north-centre disc. At first glance, this is a simple and open bipolar region with well-defined leader and trailer spots, however these also have small reverse polarity spots to the north of each of them, with the positive leader forming a weak delta configuration. This region is perhaps also connected to AR3833 to its northeast, as evident in the magnetic looping on SDO aia-171. AR3833 continues to see some slow flux emergence towards its trailer, but remains small region.

AR3825 was the source of the notable X4.5 flare on 14 Sep, but continues to simplify in the southeast, while AR3828 has seen the number of surrounding peripheral spots decline. The other spots are all small and simple. A broad area of magnetic looping remains evident in SDO imagery on the west limb, associated with AR3824, and any flares from this region may still be visible on day 1, perhaps early day 2 (21-22 Sep).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: GOES 16-18 X-ray flux



Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at background levels. AR3825 in the southwest, was previously the source of an X-class flare and cause of the S1/Minor Radiation storm on 17 Sep. However, this region has now simplified, reducing the probability for notable flares from this source during the period. AR3828 in the southeast, along with AR3831 in the northwest, have the potential to produce notable flares and will be monitored as they move into a more favourable position for producing a response at Earth. As a result, flare probabilities have been maintained at a very slight chance.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	5	5	5	5
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy flux, as observed by GOES-16 at GEO has been Moderate to High. This is due to the background to slightly elevated solar winds allowing the recent lower orbital level charging, from the CME arrival overnight on 16-17 Sep, to expand outward. While no further notable solar wind enhancements are forecast an overall declining trend is now likely, due to naturel decay, with flux seeing reduced periods of High, and perhaps easing to Background during any the diurnal minimum periods. Any fast wind onset from CH72 later on day 4 will also help to drop out any remaining flux.

The associated 24 hour fluence currently remains below the Active threshold, but has the potential to rise a little further if any more persistent High flux occurs. However, this now appears to have plateaued, and is considered more likely to remain below the Active level unless any more persistent High flux was to occur. MOSWOC REFM continues to underestimate the current fluence but does suggest a declining trend through the outlook period, supporting a reduced likelihood of now reaching the Active level.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	5	10	10	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: GOES16 24 hr >2MeV X-ray flux (top) and associated Fluence with REFM and recurrence.

